



# Factors Affecting Water-Quality Changes in the Chesapeake Bay Watershed: Implications for Restoration

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# USGS CB Studies

- Land use and watershed data and analysis
- Sediment, water clarity, and biota
- Nutrients and delivery to Bay
- Factors affecting health of fish, wildlife, and their habitat
- Disseminate information and enhance decision support

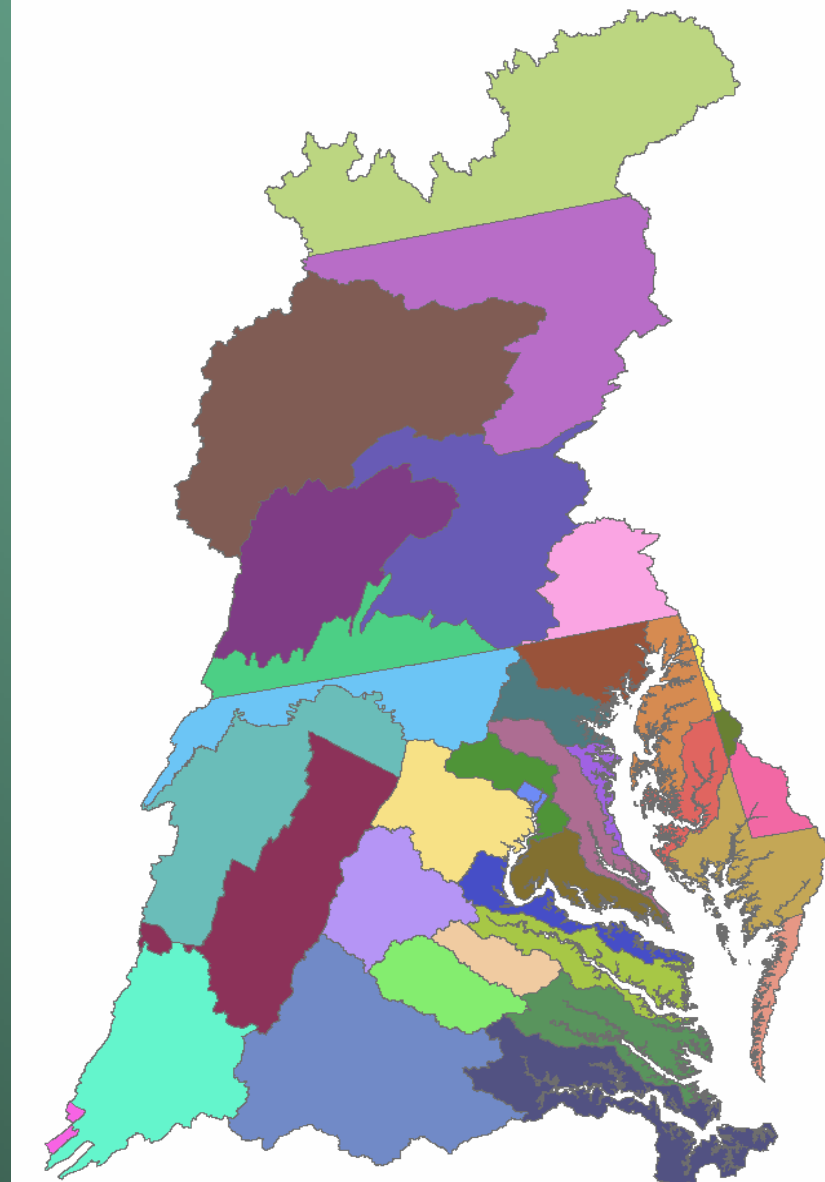


# Goals and Presentations

- Synthesis of science about water quality to help better inform implementation of management actions
- Better understand your information needs
- Outline
  - Overview of factors affecting water quality
  - Trends in water quality
  - Sources of N and P and watershed properties
  - Influence of ground water
  - Sediment sources and loads
  - Wrap up, discussion, and implications

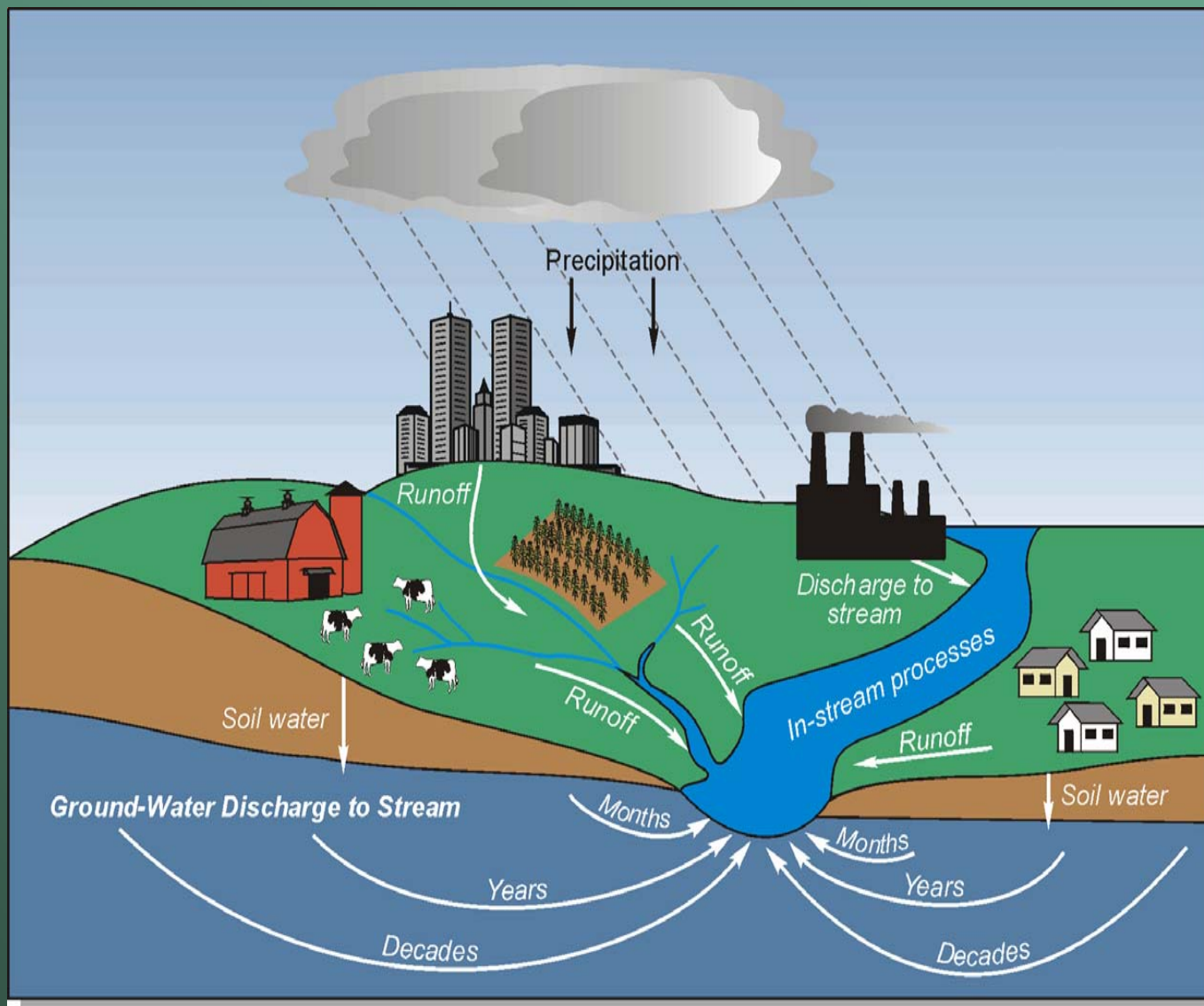
# Improving Water Quality

- Bay listed as an “impaired water body” in 1999
- Criteria/standards to be met by 2010
  - Dissolved oxygen
  - Water clarity
  - Chlorophyll
- Tributary Strategies and load allocations
  - Nitrogen
  - Phosphorus
  - Sediment
- Enhanced understanding of factors to improve implementation and assessment of management actions







# Factors Affecting Delivery and Trends

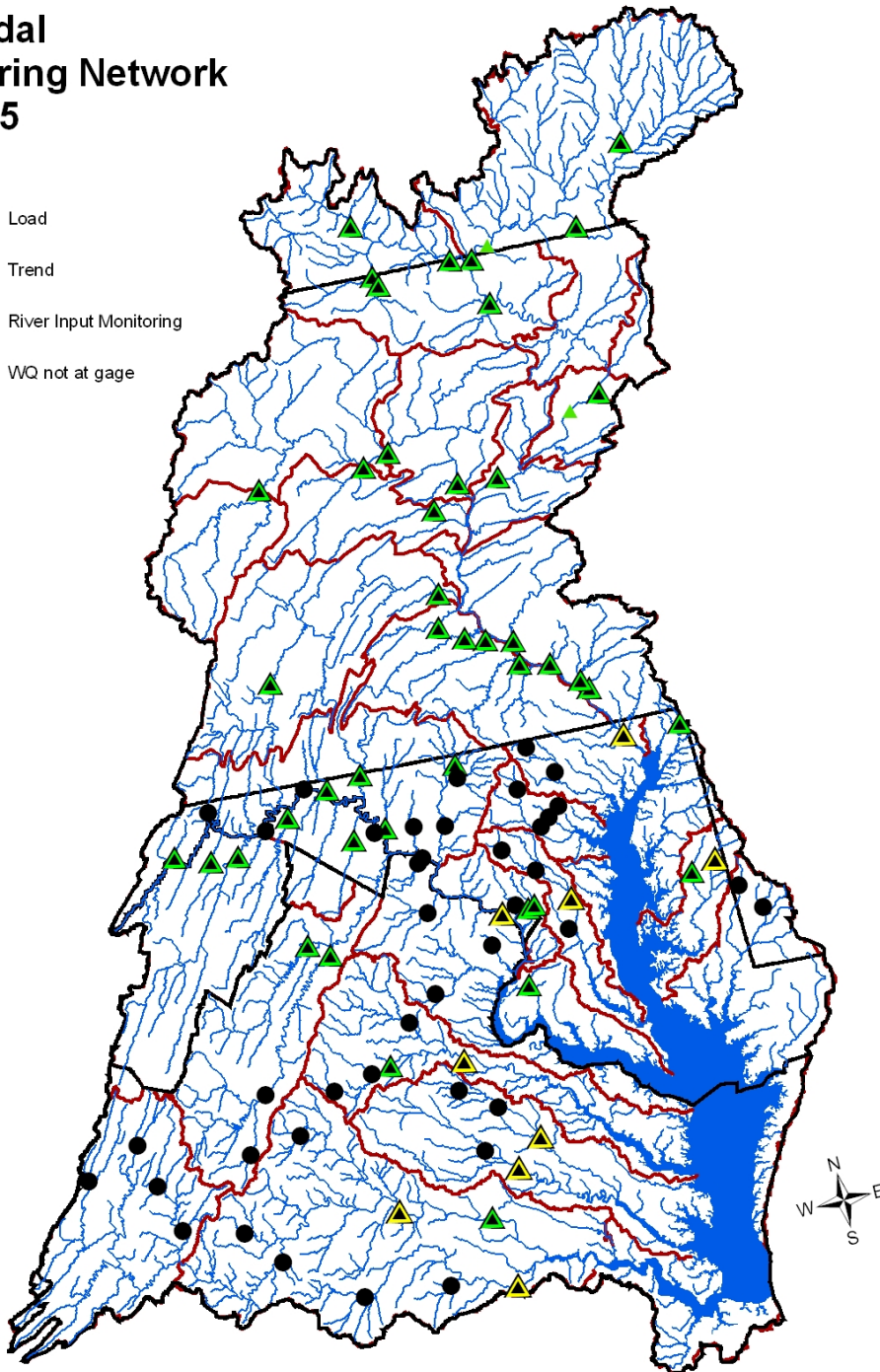
- River-flow variability
- Source changes and BMPs
- Watershed properties
  - In-stream loss and geochemical processes
- Ground water
- Residence time and storage
- “Lag Time”



## Non-Tidal Monitoring Network 04/13/05

### TYPE

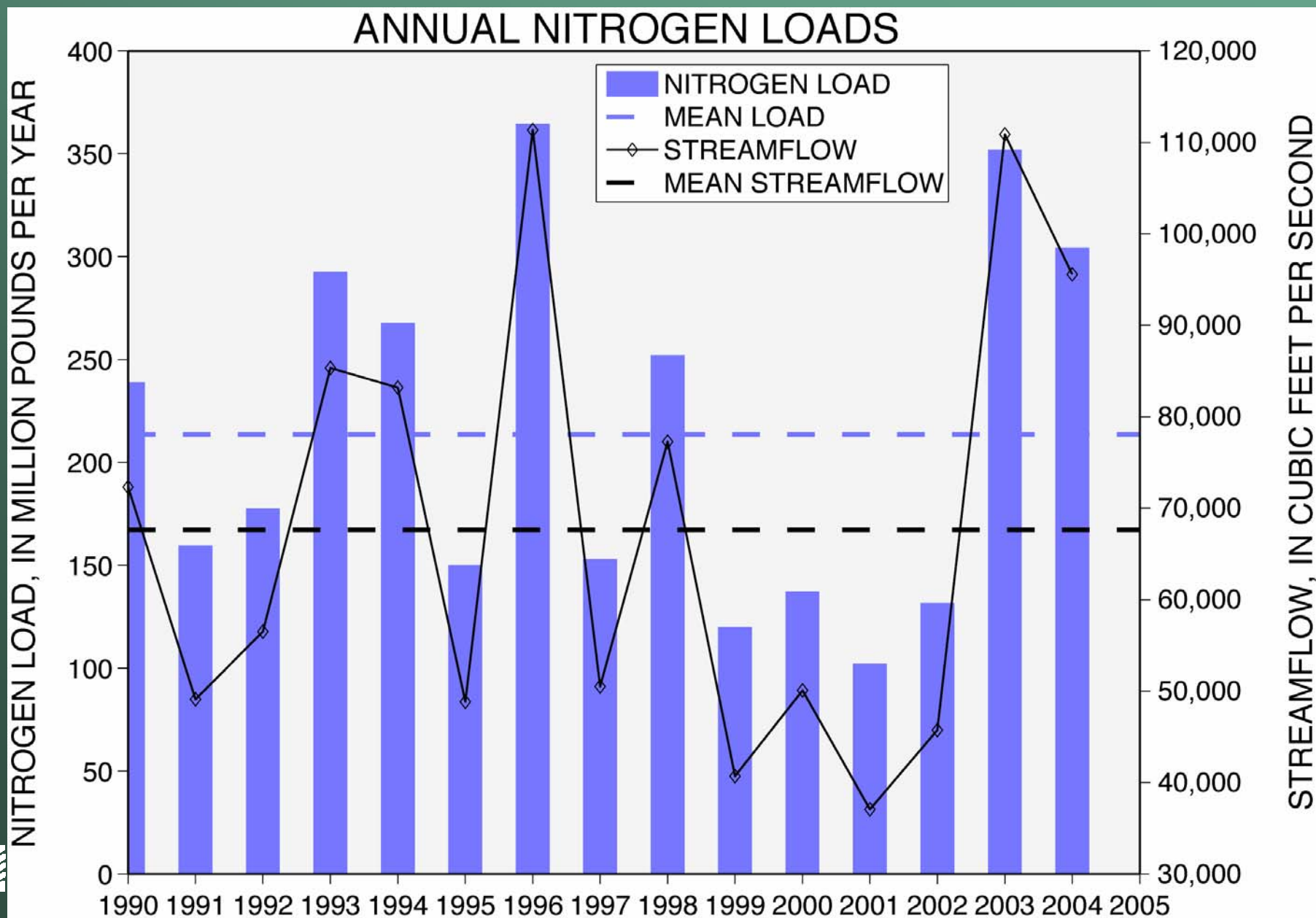
-  Load
-  Trend
-  River Input Monitoring
-  WQ not at gage



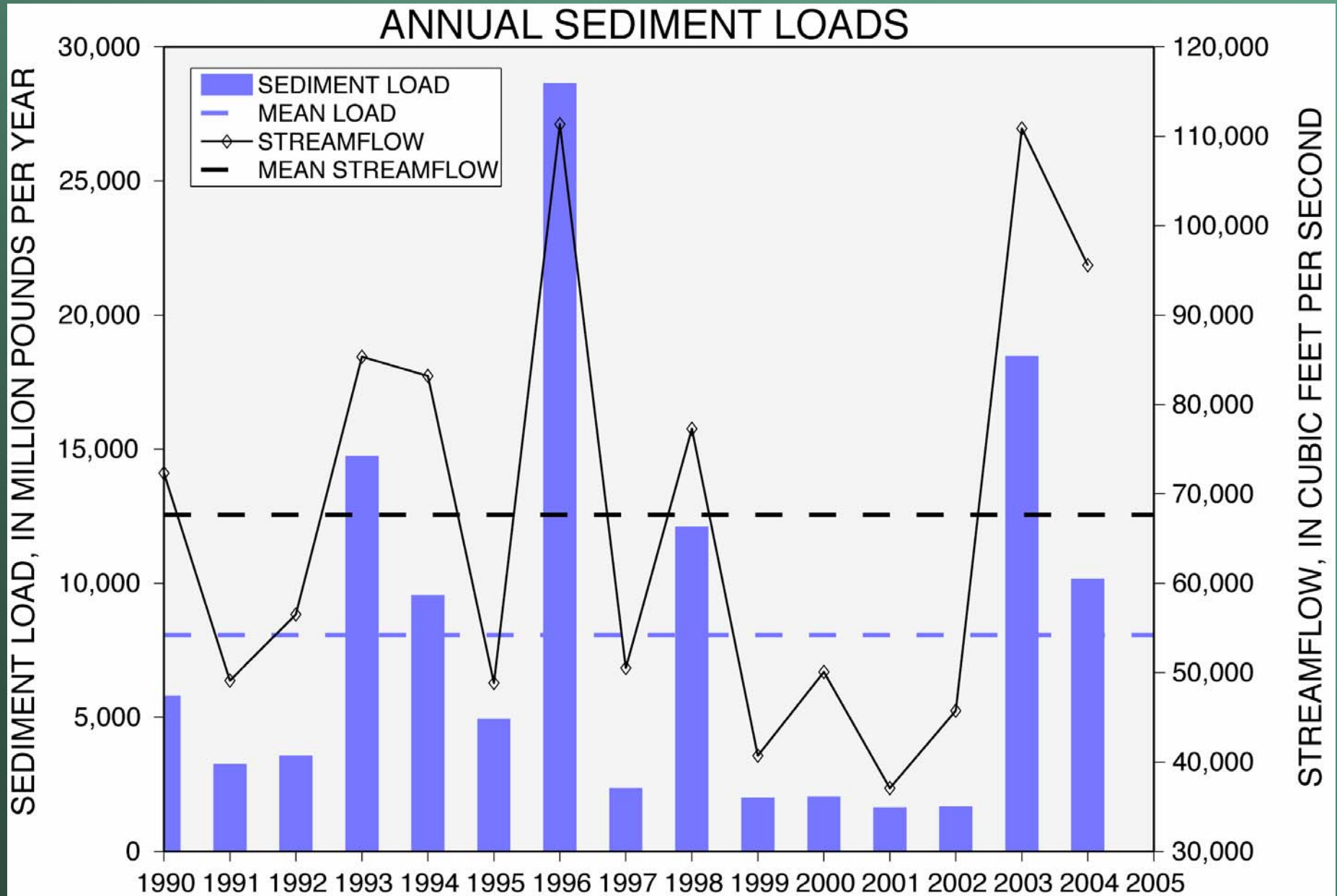
# Integration of Modeling and Monitoring

- Models used to:
  - Set criteria and load reductions
  - Relate sources and delivery factors
  - Forecast progress
  - Explain water-quality changes
- Monitoring used to:
  - Document ecosystem response
  - Attainment in tidal waters
  - Loads and trends in nontidal waters
- Integrate for improved targeting and assessment

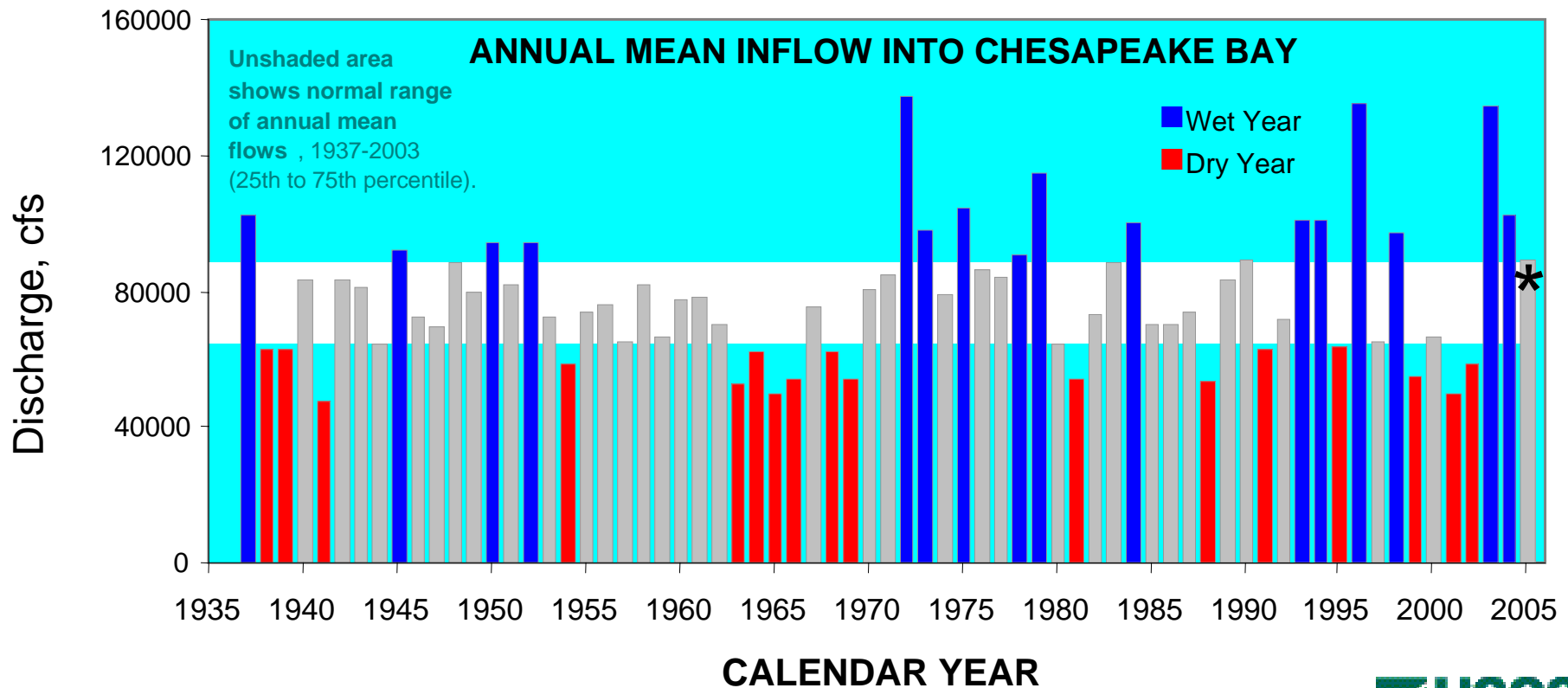
# Annual Nitrogen Loads at the River-Input Stations



# Annual Sediment Loads at the River-Input Stations



# River Flow and Implications



- Streamflow variability will have a large impact on attainment of water-quality standards in the Bay
- Design actions that help control runoff and transport of nutrients and sediment

Source: USGS

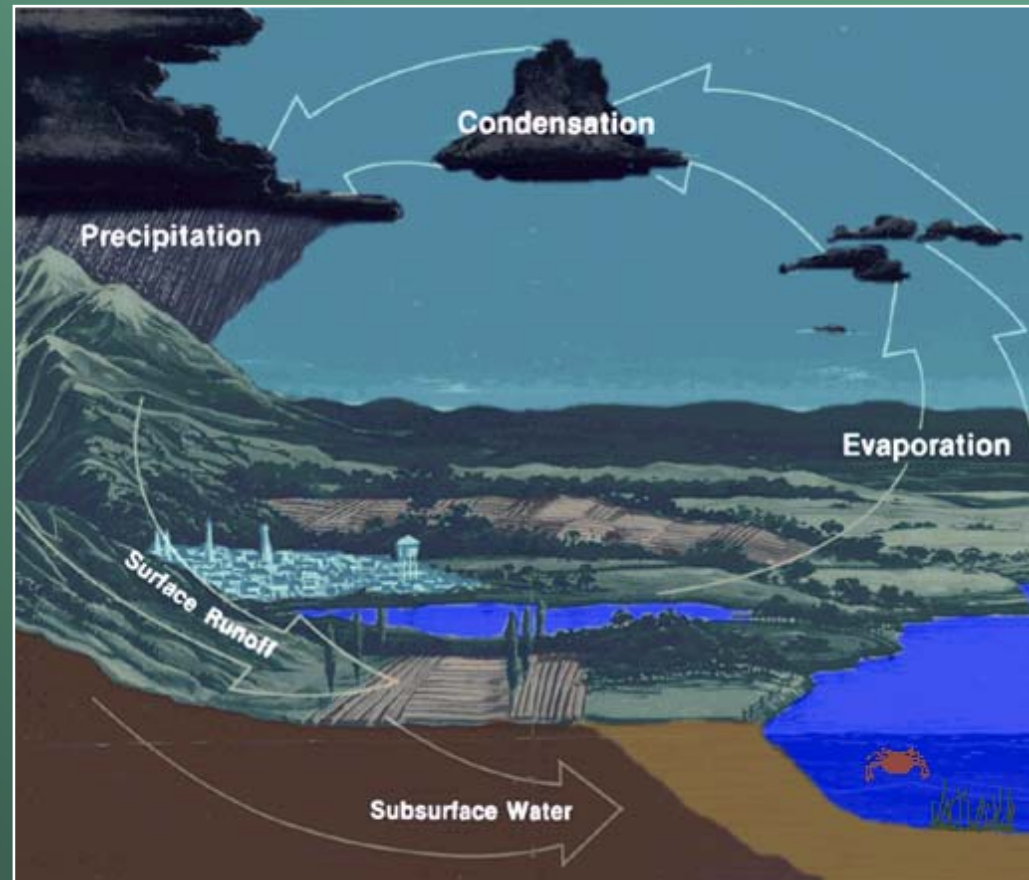


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# “Lag times” and Water-Quality Response

- Management actions
  - 1 to 5 years to implement
  - Some longer times to reach efficiency
- Watershed
  - TN
    - Days to decades
  - Sediment/TP
    - Days to decades
- Estuary
  - Seasonal



# Implications

- **Difficult to meet 2010 goals**
  - Slow reduction of nonpoint sources and population growth
  - River-flow variability
  - “Lag time”
- **Prioritize management actions**
  - Maximum efficiency
  - Most rapid improvement
- **Point source reductions**
  - Provide the most rapid improvements
- **Nonpoint Sources**
  - 80 percent of N and P
  - 100 percent of sediment
  - Varied times for improvements
- **Use residence time and delivery factors to improve implementation**



# Integrated Science for Ecosystem Conservation and Restoration

Impact of human activities on land use

Factors affecting water quality and quantity

Ability of habitat to support fish and bird populations

Synthesis and forecasting for ecosystem assessment, conservation, and restoration

